

The opinion in support of the decision being entered today
is *not* binding precedent of the Board

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE BOARD OF PATENT APPEALS
AND INTERFERENCES

Ex parte KENRO NAKAMURA,
TAKEO KUBOTA and GAKU MINAMIHABA

Appeal 2007-4403
Application 09/453,831
Technology Center 1700

Decided: September 28, 2007

Before CHARLES F. WARREN, CATHERINE Q. TIMM, and
LINDA M. GAUDETTE, *Administrative Patent Judges*.

WARREN, *Administrative Patent Judge*.

DECISION ON APPEAL

Applicants appeal to the Board from the decision of the Primary Examiner finally rejecting claims 11, 12, and 17 through 26 in the Office Action mailed May 20, 2003. 35 U.S.C. §§ 6 and 134(a) (2002); 37 C.F.R. § 1.191(a)(1) (2003); *see also* 37 C.F.R. § 41.31(a) (September 2004).

We affirm-in-part the decision of the Primary Examiner.

Claim 17 illustrates Appellants' invention of a polishing method, and is representative of the claims on appeal:

17. A polishing method comprising:
preparing a first polishing liquid containing tetravalent cerium ions in a first concentration;
adding a solvent for dilution to said first polishing liquid to form a second polishing liquid containing tetravalent cerium ions in a second concentration lower than the first concentration;
polishing a surface of a substrate containing Ru or a Ru compound in a surface region with the second polishing liquid,
wherein said addition of the solvent is carried out upon or immediately before the polishing of said substrate.

The Examiner relies on the evidence in these references:

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|--------------|--------------|---------------|
| Takikawa | US 4,574,292 | Mar. 4, 1986 |
| Danielson | US 5,407,526 | Apr. 18, 1995 |
| Westmoreland | US 6,143,192 | Nov. 7, 2000 |

Appellants request review of the following grounds of rejection advanced on appeal (Br. 6):^{1, 2}

Claims 11, 17 through 21, and 23 under 35 U.S.C. § 103(a) as unpatentable over Westmoreland in view of Danielson (Answer 3);

Claim 12 under 35 U.S.C. § 103(a) as unpatentable over Westmoreland in view of Danielson as applied, further in view of Takikawa (*id.* 5); and

¹ The Examiner refers to claim 23 in explaining the first ground of rejection and to claim 25 in explaining the third ground of rejection, and accordingly, these claims stand so rejected even if not set forth in the statements of the ground of rejection.

² The rejection of claims 24 and 26 under 35 U.S.C. § 112, first paragraph, written description requirement, is withdrawn by the Examiner. Answer 2. The Examiner does not include claims 24 and 26 in any ground of rejection advanced on appeal and does not hold the claims allowable.

Claims 22 and 25 under 35 U.S.C. § 103(a) as unpatentable over Westmoreland in view of Danielson (*id.* 6)

Appellants argue claims 11, 17 through 21, and 23 as a group with respect to the first ground of rejection, and claims 12 and 22 as representative of the second and third grounds of rejection, respectively. We point out Appellants state claim 23, dependent on claim 17, and claim 25, dependent on claim 22, stand alone but do not submit separate argument with respect thereto. Br. 6. Thus, we decide this appeal based on claims 12, 17, and 22 as representative of the grounds of rejection. 37 C.F.R. § 1.192(c)(7)(2003); *see also* 37 C.F.R. § 41.37(c)(1)(vii)(September 2004).

The plain language of independent claim 17 specifies a method for polishing in any manner any surface of any substrate containing any amount of Ru, that is, ruthenium, or any Ru containing compound in a surface region, comprising at least the steps of preparing any polishing liquid composition containing at least some amount of tetravalent cerium ions in a first concentration; and upon or immediately before polishing the surface, adding any solvent to the first polishing liquid composition to reduce the concentration of the tetravalent cerium ions present to prepare a second polishing liquid composition for application to the surface. Independent claim 22 differs from claim 17 in specifying the first polishing liquid composition contains cerium (IV) nitrate. Claim 12, dependent on claim 17, specifies the Ru compound is SrRuO_3 . The open-ended terms “comprising” and “containing” opens the claims to include any manner of other ingredients in the first and second polishing liquid compositions, such as particulate liquid polishing and etching agents. *See, e.g., Exxon Chem. Pats., Inc. v. Lubrizol Corp.*, 64 F.3d 1553, 1555, 35 USPQ2d 1801, 1802

(Fed. Cir. 1995) (“The claimed composition is defined as comprising - meaning containing at least - five specific ingredients.”); *In re Baxter*, 656 F.2d 679, 686, 210 USPQ 795, 802 (CCPA 1981) (“As long as one of the monomers in the reaction is propylene, any other monomer may be present, because the term ‘comprises’ permits the *inclusion* of other steps, elements, or materials.”).

We find Westmoreland would have disclosed to one of ordinary skill in this art methods for removing at least a portion of a structure, such as a layer, film, coating, or other deposit, composed of Ru or RuO₂, that is ruthenium dioxide, or a combination thereof, including planarization by chemical mechanical planarization, using ceric ammonium nitrate, that is, ammonium cerium (IV) nitrate. Westmoreland, e.g., Abstract, col. 1, ll. 18-24 and 38-39, col. 1, l. 67 to col. 2, l. 8., col. 2, l. 66 to col. 3, l. 16, and col. 5, ll. 1-4 and 10-32. The ceric ammonium nitrate can be dissolved in liquid water and the composition can optionally contain other liquid or solid solutes, wherein the liquid composition can contain about 0.5 to about 70 weight percent ceric ammonium nitrate. *Id.* col. 3, ll. 41-60. The chemical mechanical planarization process removes ruthenium metal and/or ruthenium dioxide using, in addition to ceric ammonium nitrate, “frictional force, such as mechanical abrasion, to the slurry on the surface,” and can be conducted using parameters readily determined by one of ordinary skill in the art. *Id.* col. 5, ll. 10-32. Westmoreland discloses that amorphous ruthenium dioxide was removed but crystalline ruthenium dioxide was not when samples films on different substrates were immersed in a commercial chrome etchant composition which contained acetic acid and used to etch

chromium and chromium dioxide. *Id.*, e.g., Abstract and col. 7, l. 58 to col. 8, l. 60.

We find Danielson would have disclosed to one of ordinary skill in this art a method of delivering a polishing slurry for etching a substrate, wherein the slurry chemicals are mixed at the point of use. Danielson, e.g., Abstract, col. 2, ll. 7-10, and col. 5, ll. 6-14. Danielson discloses that the methods address such acknowledged problems using bulk slurries in chemical mechanical polishing (CMP) processes as “dynamic changes of slurry chemistry are not feasible, and the fact that most premixed slurries are not within the limited ranges of slurry mixtures which are effective.” *Id.* col. 1, ll. 49-54.

We find Takikawa would have disclosed to one of ordinary skill in this art that a deposited strontium ruthenium trioxide film, SrRuO_3 , formed from ruthenium dioxide and strontium oxide, is “a very stable structure” at an atomic ratio M/Ru, that is metal and ruthenium, of 1, wherein the preferred ratio range is 0.9 to 1.2. Takikawa, e.g., col. 2, ll. 7-51.

The issues in this appeal are whether the Examiner has carried the burden of establishing a prima facie case of obviousness in the grounds of rejection advanced on appeal.

There is no dispute that the cerium (IV) nitrates encompassed by claim 22 provide tetravalent cerium ions encompassed by claim 17, and accordingly, we consider the ground of rejection of claim 22 subsumed in that of claim 17, the combination of references applied in both grounds in the same manner.

With respect to this ground of rejection, the Examiner concludes the combined teachings of Westmoreland and Danielson would have suggested to one of ordinary skill in this art to add water to an aqueous solution of ceric ammonium nitrate to obtain a desired concentration for use in a chemical mechanical planarization polishing method upon or immediately before polishing the substrate in the reasonable expectation of creating slurries that provide superior polish and etching rates. Answer 3-5 and 6-8. The Examiner contends this person would have recognized dilution of a first liquid composition to obtain a second liquid composition are conventional for preparing final compositions of desired concentration, and since Westmoreland discloses solutions with amount and concentrations ranges, “it would naturally encompass conventional preparation steps to attain the desired final concentration,” thus leading to the claimed dilution step. *Id.* 9 and 12-13. The Examiner contends Danielson can be combined with Westmoreland because Danielson discloses methods of preparing abrasive solutions by mixing ingredients together in a solution to form a slurry. *Id.* 10-11 and 13-14.

Appellants contend the teachings of Westmoreland and Danielson would not have taught the claimed process, pointing out Westmoreland refers to only a single bath for etching purposes as shown in the illustrative examples. Br. 14 and 26-27. Appellants contend Westmoreland further does not disclose the claimed process because an illustrative example establishes crystalline ruthenium dioxide was not removed by the commercial chrome etchant, pointing out that the Specification discloses substrates of conductive oxides of perovskite-type crystal structure of films

of ruthenium and ruthenium compounds such as ruthenium dioxide, including strontium ruthenium trioxide. Br. 15-16 and 27-28; Reply Br. 5-6. Appellants contend Danielson produces only one solution by mixing an oxidant with an abrasive solution to form a slurry liquid, and does not disclose ceric compounds. *Id.* 16-17 and 29. Thus, Appellants contend there is no motivation to combine and there is no reasonable expectation that combining the references would successfully result in the claimed polishing method. *Id.* 19-21 and 30-33.

We determine the combined teachings of Westmoreland and Danielson, the scope of which we determined above, provide convincing evidence supporting the Examiner's case that the claimed invention encompassed by claims 17 and 22, as we interpreted these claims above, would have been prima facie obviousness of to one of ordinary skill in the semiconductor surface polishing arts familiar with chemical mechanical planarization. Indeed, as the Examiner points out, this person would have been armed with the knowledge in the art that liquid polishing compositions require adjustment with respect to the presence and concentration of ingredients therein and the surface to be polished, as acknowledged and disclosed by Danielson. Consequently, adjusting the liquid polishing composition by the addition of further solvent and/or other ingredients which would can lower the concentration of the materials in the initial composition being adjusted would have been a successful routine expedient that this person would have employed in following the teachings with respect to chemical mechanical planarization of a surface containing

ruthenium and/or ruthenium dioxide with an aqueous composition containing ceric ammonium nitrate in Westmoreland.

Accordingly, one of ordinary skill in this art would have combined the teachings of Westmoreland and Danielson and thus, would have been led to the claimed processes encompassed by claims 17 and 22, including all of the limitations thereof arranged as required therein, without resort to Appellants' Specification. *See, e.g., KSR Int'l Co. v. Teleflex, Inc.*, 127 S. Ct. 1727, 1741, 82 USPQ2d 1385, 1389 (2007) (analysis supporting obviousness should "identify a reason that would have prompted a person of ordinary skill in the art to combine the elements" in the manner claimed); *In re Kahn*, 441 F.3d 977, 985-88, 78 USPQ2d 1329, 1334-37 (Fed. Cir. 2006); *In re Dow Chem. Co.*, 837 F.2d 469, 473, 5 USPQ2d 1529, 1531 (Fed. Cir. 1988);³ *In re Keller*, 642 F.2d 413, 425, 208 USPQ 871, 881 (CCPA 1981);⁴ *In re Sovish*, 769 F.2d 738, 743, 226 USPQ 771, 774 (Fed.

³ The consistent criterion for determination of obviousness is whether the prior art would have suggested to one of ordinary skill in the art that [the claimed process] should be carried out and would have a reasonable likelihood of success viewed in light of the prior art. [Citations omitted] Both the suggestion and the expectation of success must be founded in the prior art, not in the applicant's disclosure.

Dow Chem., 837 F.2d at 473, 5 USPQ2d at 1531.

⁴ The test for obviousness is not whether the features of a secondary reference may be bodily incorporated into the structure of the primary reference; nor is it that the claimed invention must be expressly suggested in any one or all of the references. Rather, the test is what the combined teachings of the references would have suggested to those of ordinary skill in the art.

Keller, 642 F.2d at 425, 208 USPQ at 881.

Cir. 1985) (skill is presumed on the part of one of ordinary skill in the art); *In re Bozek*, 416 F.2d 1385, 1390, 163 USPQ 545, 549 (CCPA 1969) (“Having established that this knowledge was in the art, the examiner could then properly rely, as put forth by the solicitor, on a conclusion of obviousness ‘from common knowledge and common sense of the person of ordinary skill in the art without any specific hint or suggestion in a particular reference.’”); *see also In re O’Farrell*, 853 F.2d 894, 903-04, 7 USPQ2d 1673, 1681 (Fed. Cir. 1988) (“Obviousness does not require absolute predictability of success. . . . For obviousness under § 103, all that is required is a reasonable expectation of success.” (citations omitted)).

Appellants’ contentions do not successfully rebut the prima facie case. We find no teaching or inference in Westmoreland which would have led one of ordinary skill in this art to prepare only a single composition from specific ingredients in following the teachings of the reference with respect to chemical mechanical planarization processes, and indeed, the teachings on which Appellants rely are directed to an etching bath. Furthermore, Westmoreland clearly would have disclosed the removal of at least a portion of ruthenium and ruthenium dioxide from surface, regardless of the evidence with respect to crystalline ruthenium dioxide. In any event, there is no limitation on ruthenium and compounds thereof in claims 17 and 22. *See In re Self*, 671 F.2d 1344, 1348, 213 USPQ 1, 5 (CCPA 1982). We likewise find no teachings in Danielson which would have led one of ordinary skill in this art to prepare only a single composition because the reference discloses adjusting compositions at the time of application thereof

to the substrate, which adjustment of one composition would, of course, result in a second composition.

Accordingly, based on our consideration of the totality of the record before us, we have weighed the evidence of obviousness found in the combined teachings of Westmoreland and Danielson with Appellants' countervailing evidence of and argument for nonobviousness and conclude that the claimed invention encompassed by appealed claims 11, 17 through 23, and 25 would have been obvious as a matter of law under 35 U.S.C. § 103(a).

We do not reach the same conclusion with respect to the process of claim 12 and the combined teachings of Westmoreland, Danielson and Takikawa. On this record, we agree with Appellants that Westmoreland would not have reasonably suggested that ceric ammonium nitrate can be used to remove a portion of strontium ruthenium trioxide from a surface by chemical mechanical planarization. Br. 23-24. Indeed, the Examiner's contention that strontium ruthenium trioxide can be substituted for ruthenium and its dioxide is based on suitability of use of the material and not with respect to polishing the same in a chemical mechanical planarization process. Answer 6 and 11-12.

Accordingly, in the absence of a prima facie case of obviousness, we reverse the ground of rejection of claim 12 under 35 U.S.C. § 103(a).

The Primary Examiner's decision is affirmed-in-part.

Other Issues

We observed that appealed dependent claims 24 and 26 are not subject to a ground of rejection in the Answer. *See above* note 2. These

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claims are drawn to processes in which the first polishing liquid composition can be water and the solvent diluting the liquid composition can also be water. *See* independent claims 17 and 22. Westmoreland discloses aqueous composition for chemical mechanical planarization processes.

Accordingly, the Examiner should consider claims 24 and 26 with respect to the combined teachings of Westmoreland and Danielson as we applied these references above, in any further prosecution of the appealed claims subsequent to the disposition of this appeal.

No time period for taking any subsequent action in connection with this appeal may be extended under 37 C.F.R. § 1.136(a)(1)(iv) (2006).

AFFIRMED-IN-PART

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